Soil Health Ecosystem Services Valuation in VT

A Report to the Vermont Soil-Health Working Group

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Outline

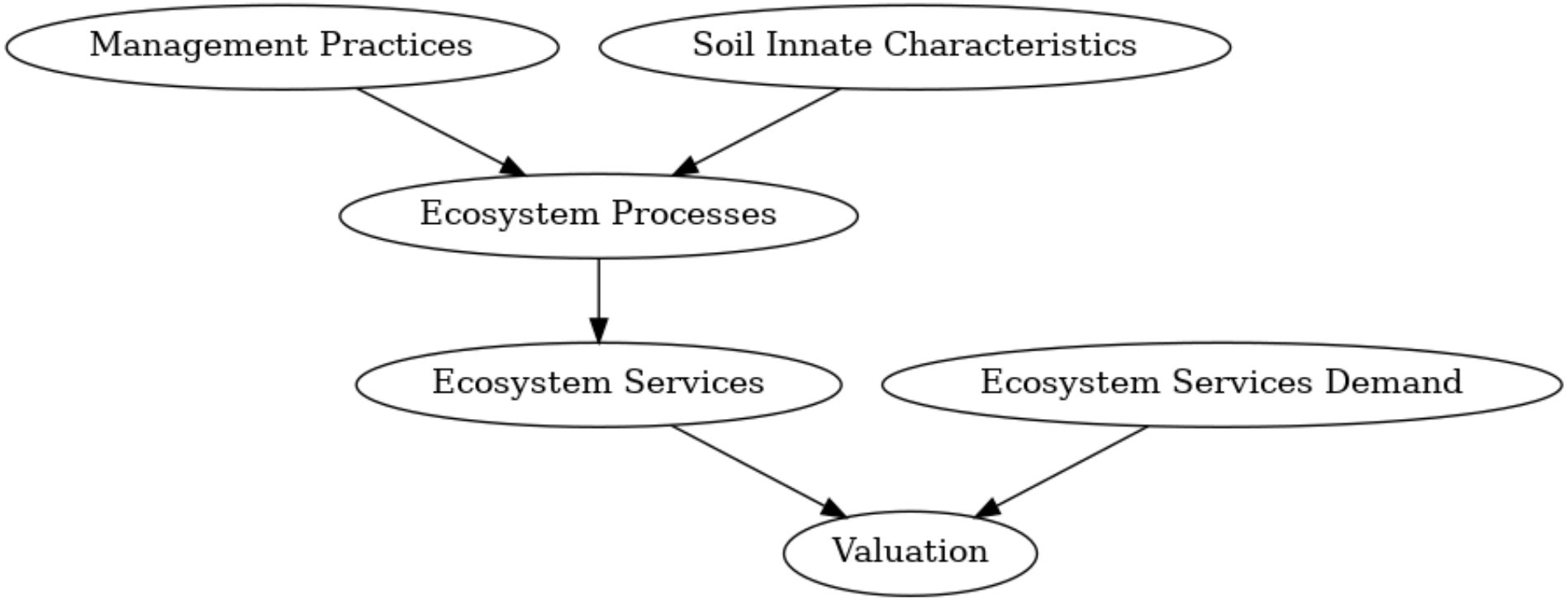
- Our Approach
- Overall Results
- Summaries for 4 services:
  - Flood Mitigation
  - Erosion Control
  - P Loss
  - Soil Carbon

Two Approaches

- Estimate Impacts of Soil-Health Practice Scenarios (relating to task 2)

- Estimate Impacts of Soil-Health Improvement Scenarios

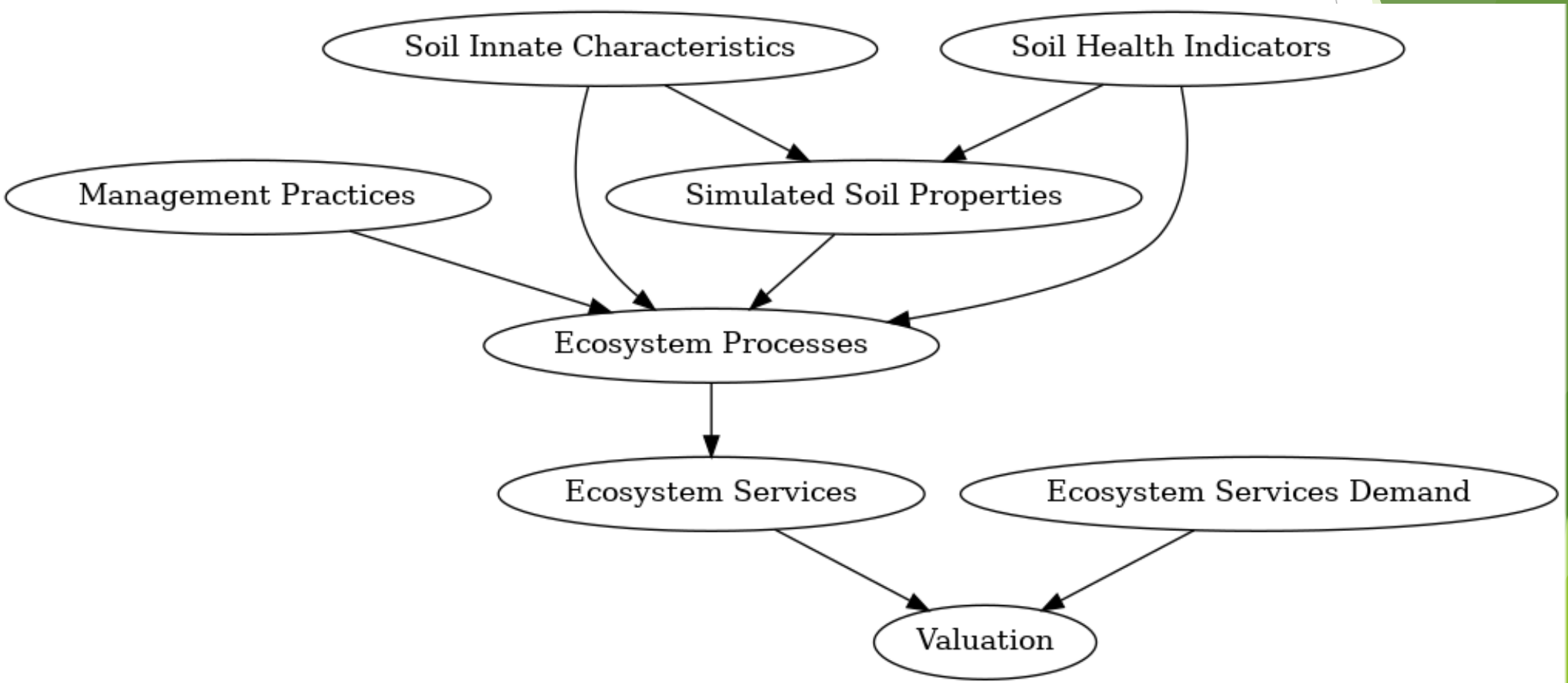
Estimating Based on Practice Scenarios



Practices: Methods

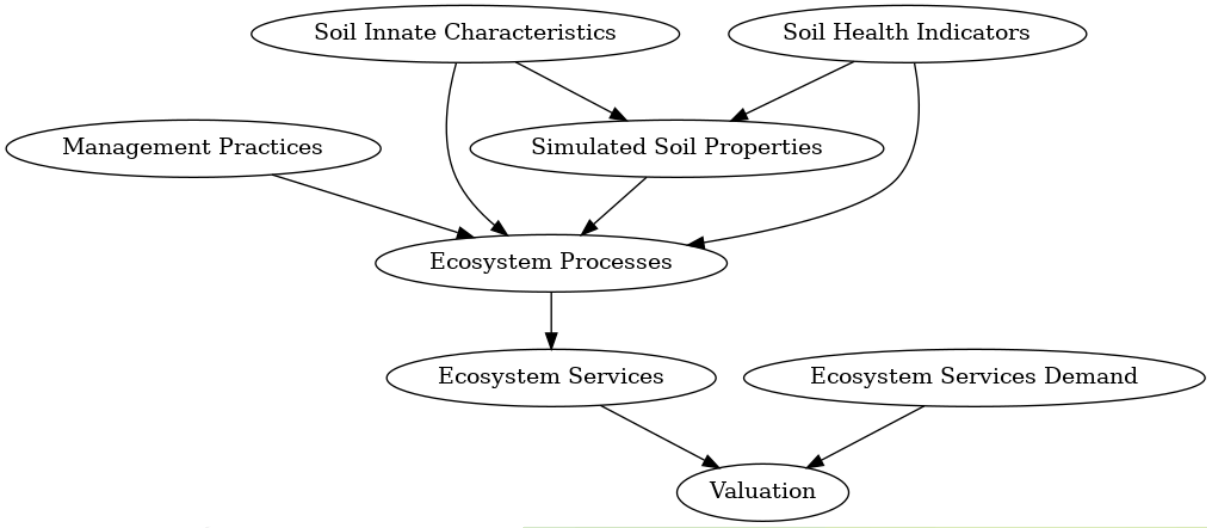
- We use a set of empirical models that link changes in practices to these ecosystem functions
- Erosion: Universal Soil Loss Equation
- Runoff: The Curve-Number Method
- Phosphorus Loss: the P-Index

Estimating Based on Soil Health Improvements

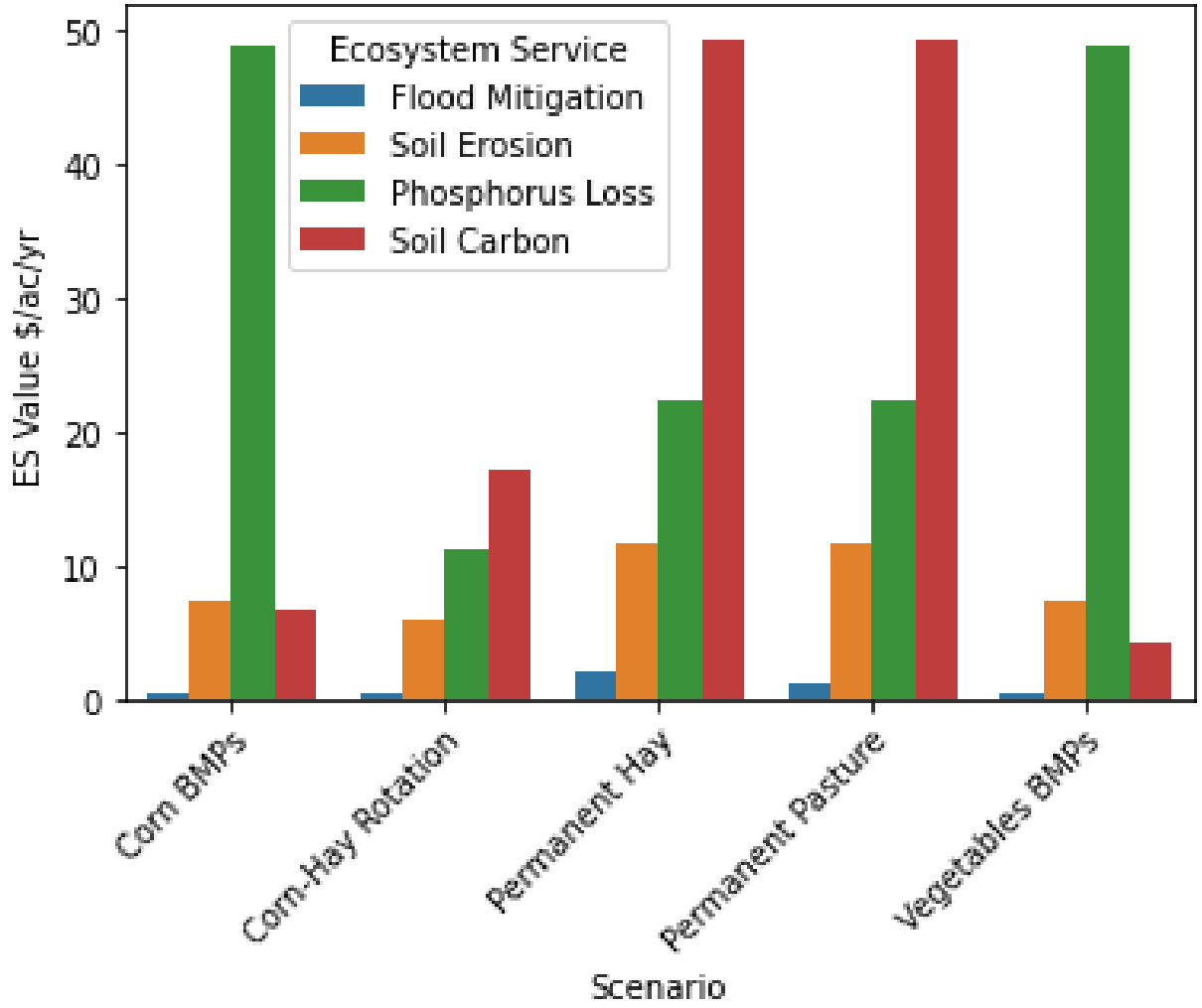


Estimating Based On Soil Health Improvements

- We use a set of 10 of the most common high ag-value soil series in VT, data from NRCS.
- Innate Characteristics: e.g. Texture
- Indicators: e.g. SOM, Bulk Density
- Simulated Properties: e.g. Plant Available Water Capacity, Saturated Hydraulic Conductivity.
- We present results for two improvement scenarios:
  - "Best" : SOM ↑ 50%, Bulk Density ↓ 20%
  - "Good" : SOM ↑ 25%, Bulk Density ↓ 10%

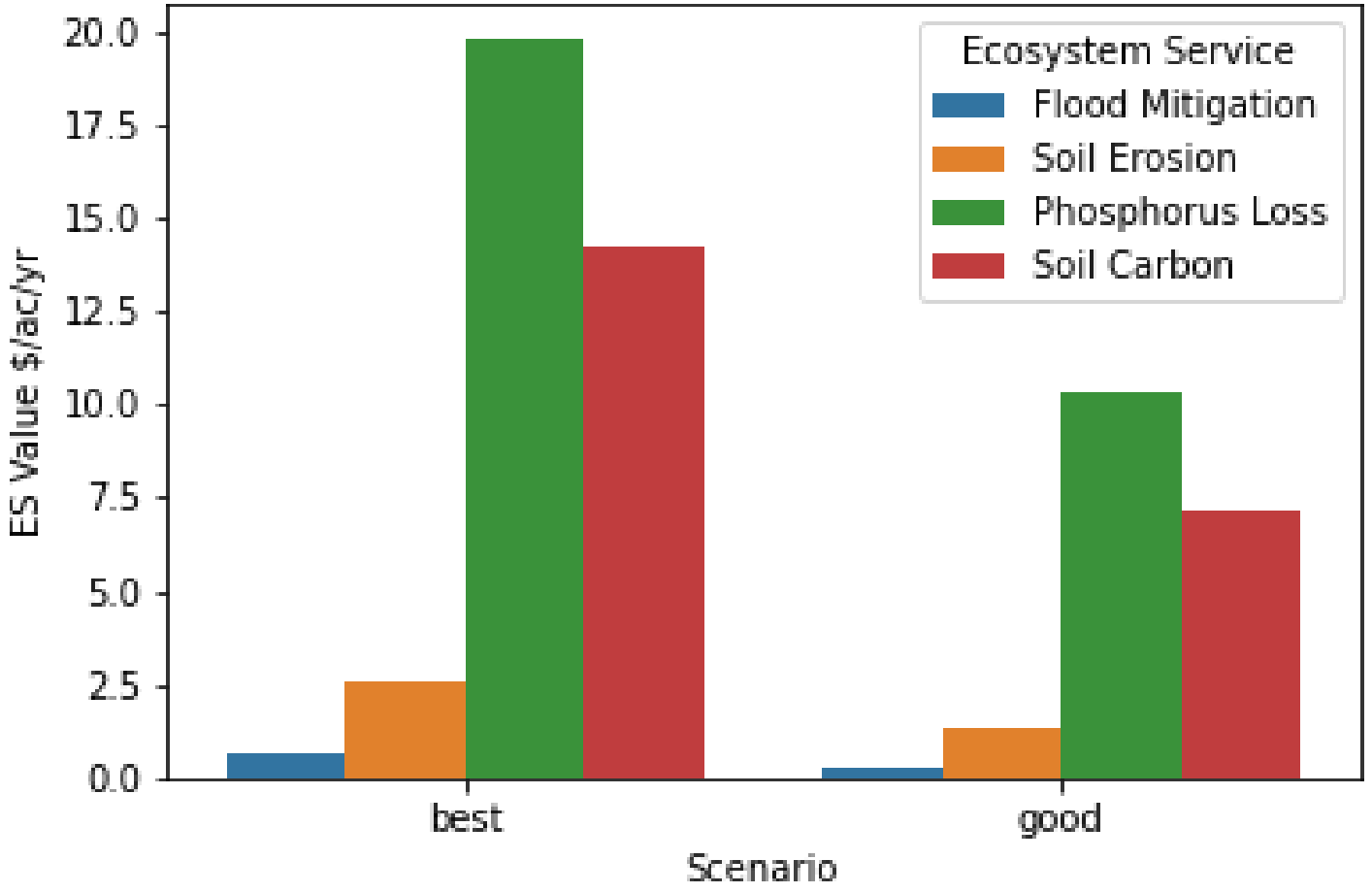


Total ES Values: Practice



*Based on Changing from Conventional-Tillage Corn

Total ES Values: Soil Improvement

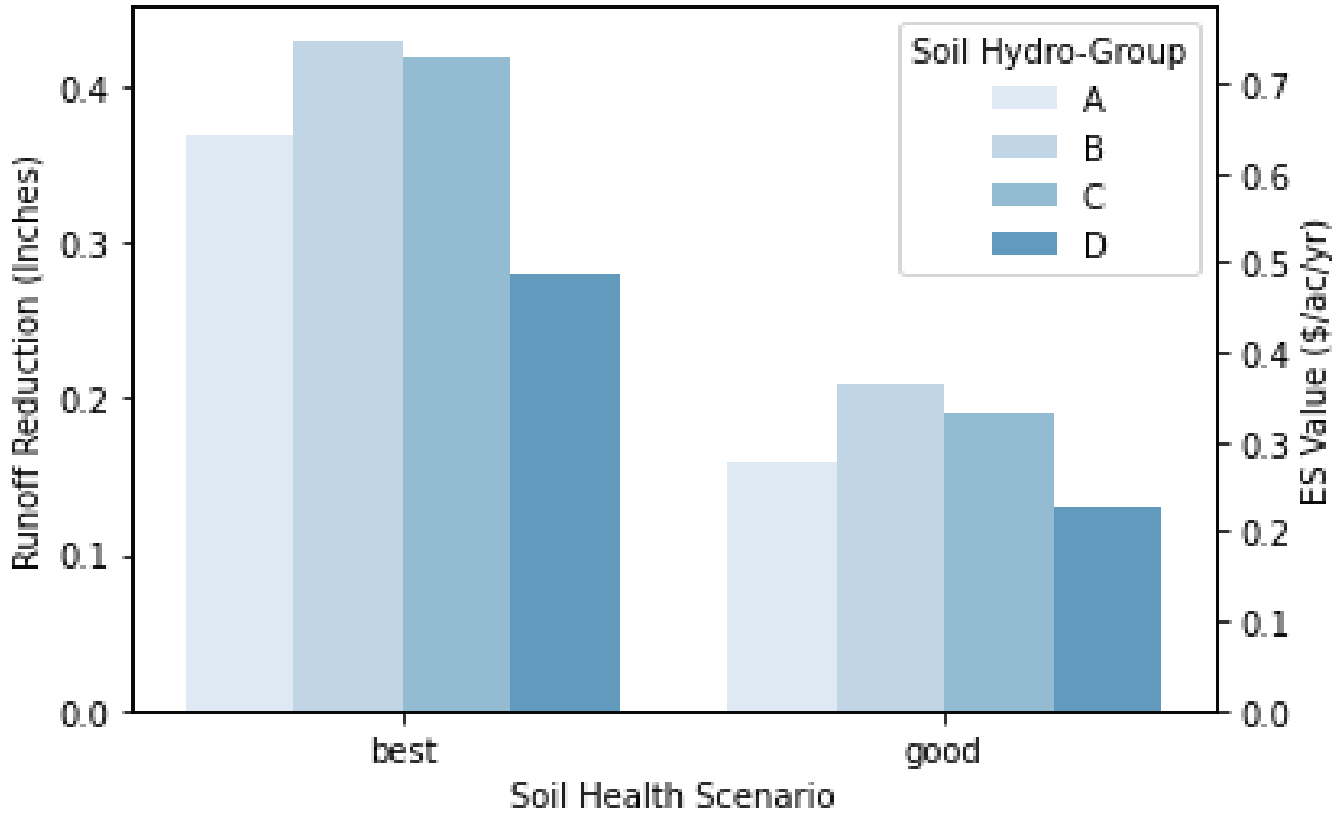


- **“Best”: $37/acre/year.**
- **“Good” : $19/acre/year**

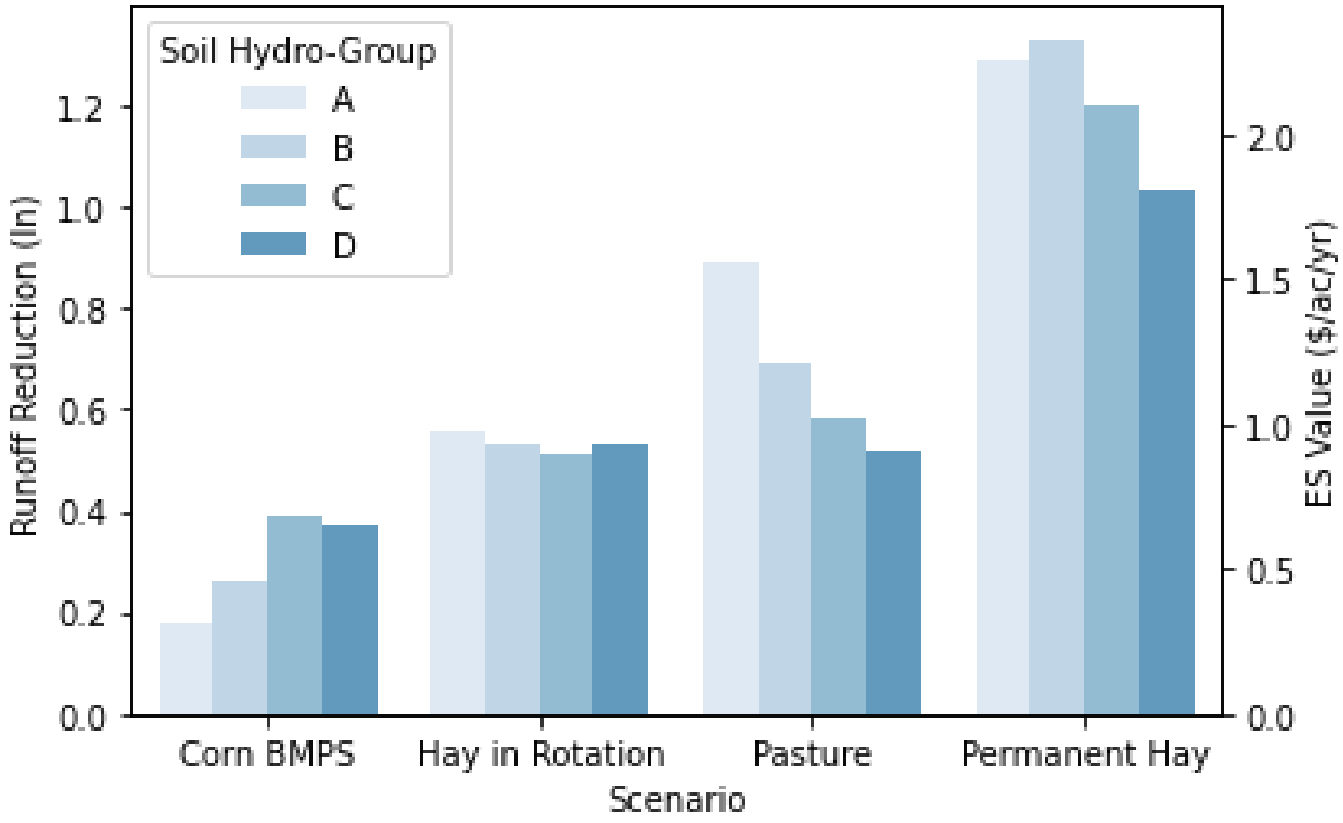
Flooding: Summary

- We estimate the value of mitigating runoff during extreme storm events.
- We estimate the value for the average VT farm field at $1.75/acre-inch.
- Agriculture in VT is mostly in locations with relatively low flood mitigation value.
- Soil-health practices and soil-health improvements are estimated to mitigate extreme-storm runoff by between 1/8-inch to 1 inch.

Flooding Results: Soil-Improvement



Flooding Results: Practices



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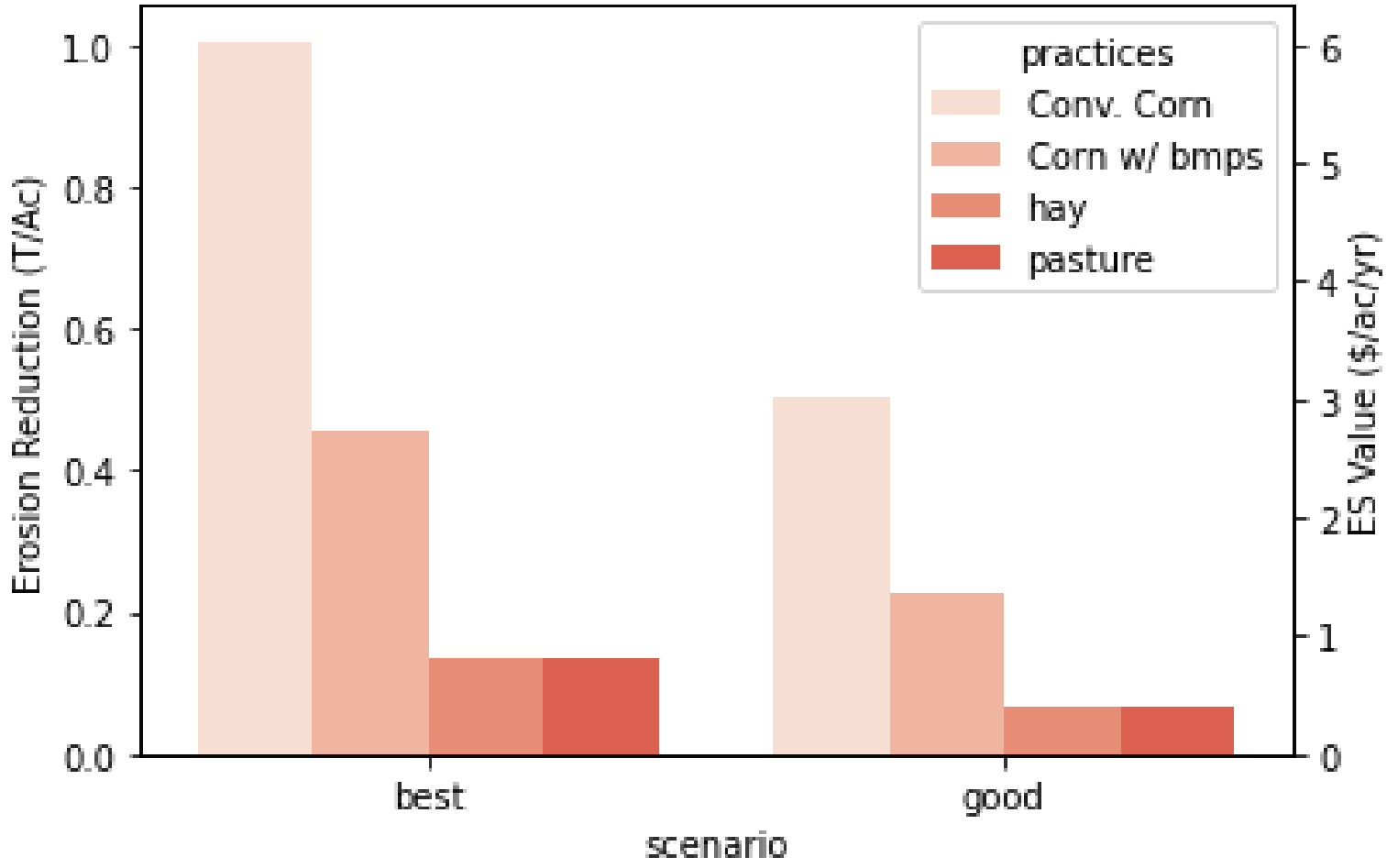
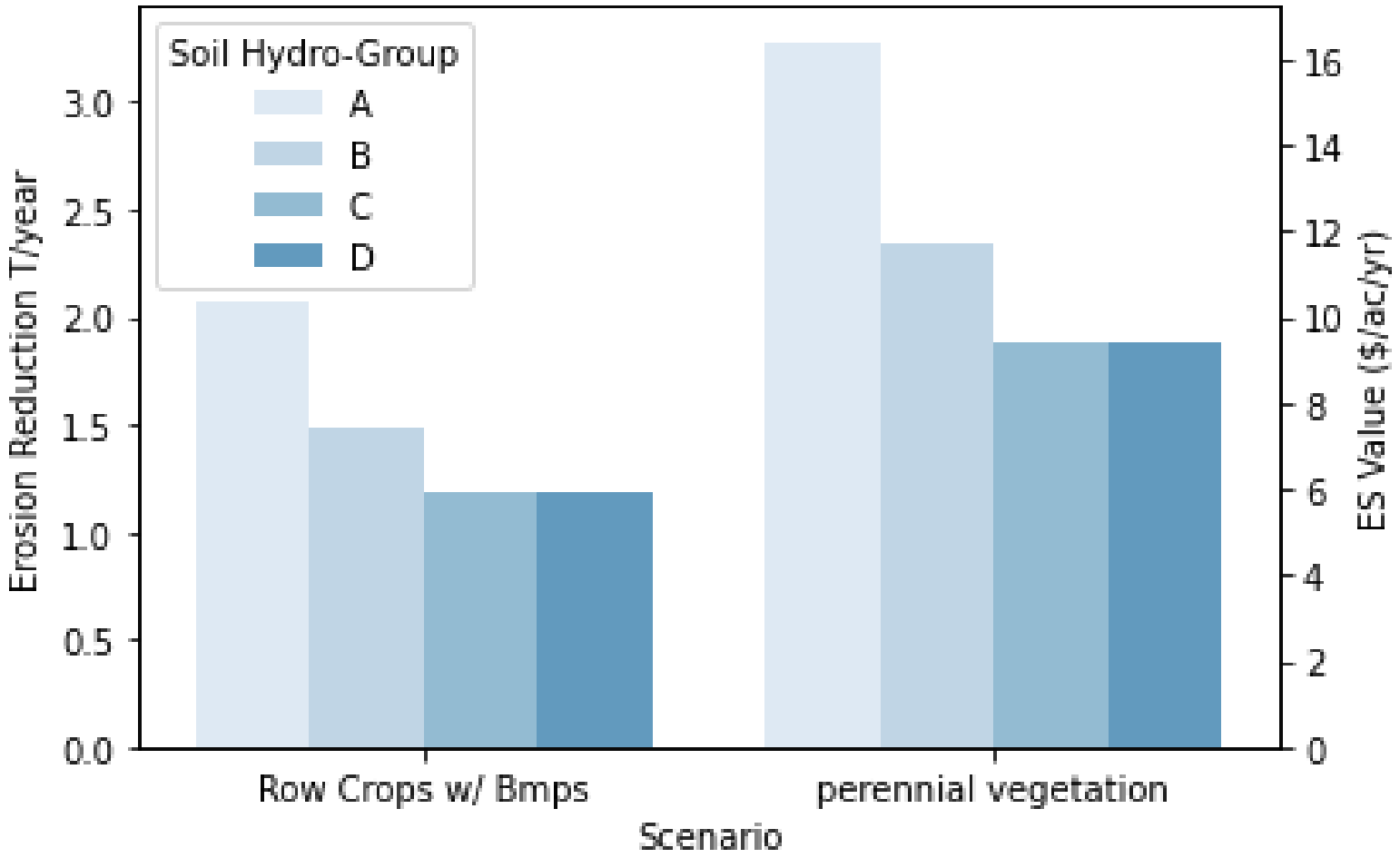
Soil Erosion: Summary

- We use a literature value for the economic harms of Erosion (excluding eutrophication): $6/Ton.
- We use the USLE to estimate soil loss.
- We estimate changes from soil-health by estimating the change in the soil erodibility factor, which is influenced by organic matter levels and saturated hydraulic conductivity.

Erosion Results: Soil Health Indicators Grouped by Practice



Soil Erosion Results: Practices



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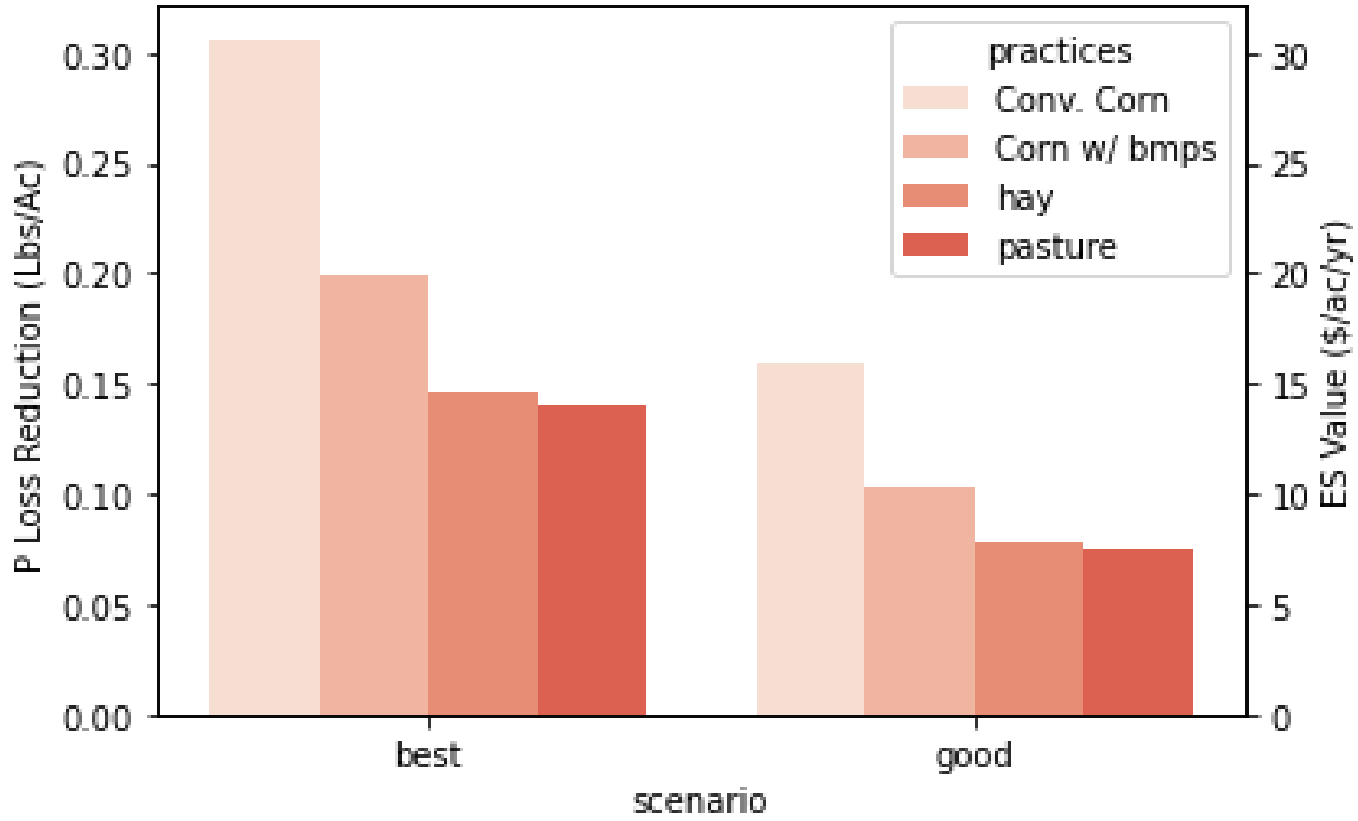
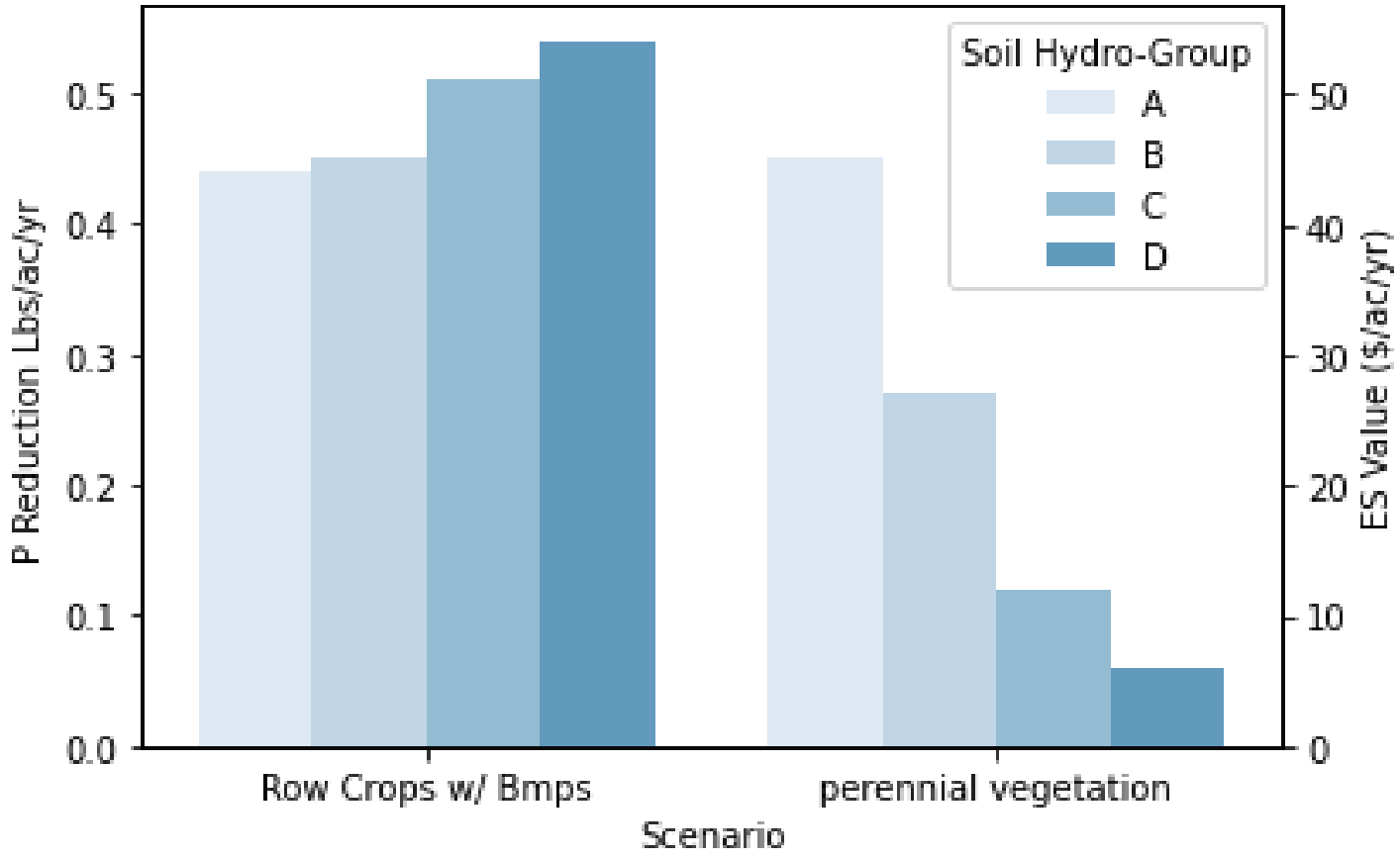
Phosphorus Loss Summary

- ***These estimates are not reliable for fields with strong sub-surface connections to surface water.*** (e.g. Tile)
- Based on the abatement curves of WWTF, we estimate a $100/lb social cost of P.
- We estimate reductions using the VT P Index.

P Mitigation: Soil Indicators Grouped by Practices



P Mitigation Results: Practices



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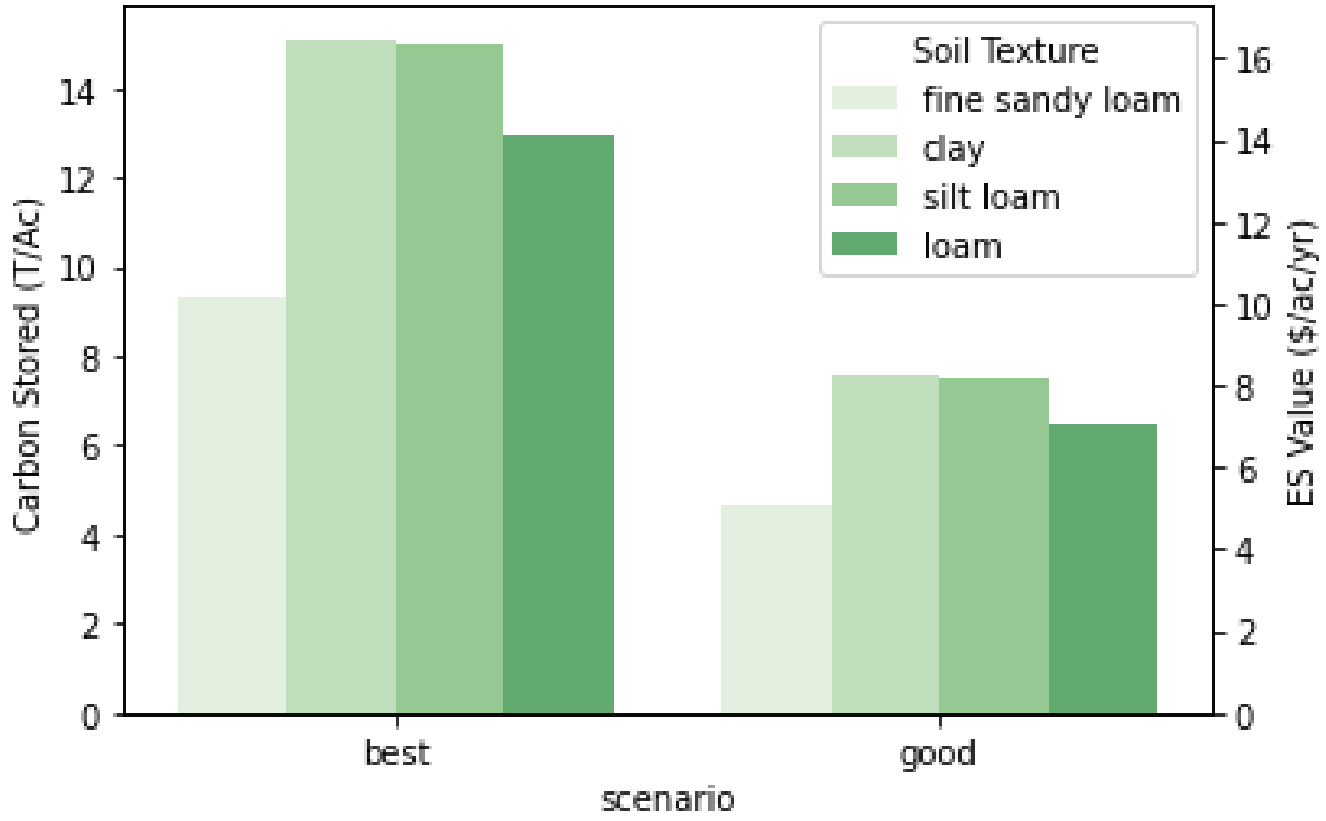
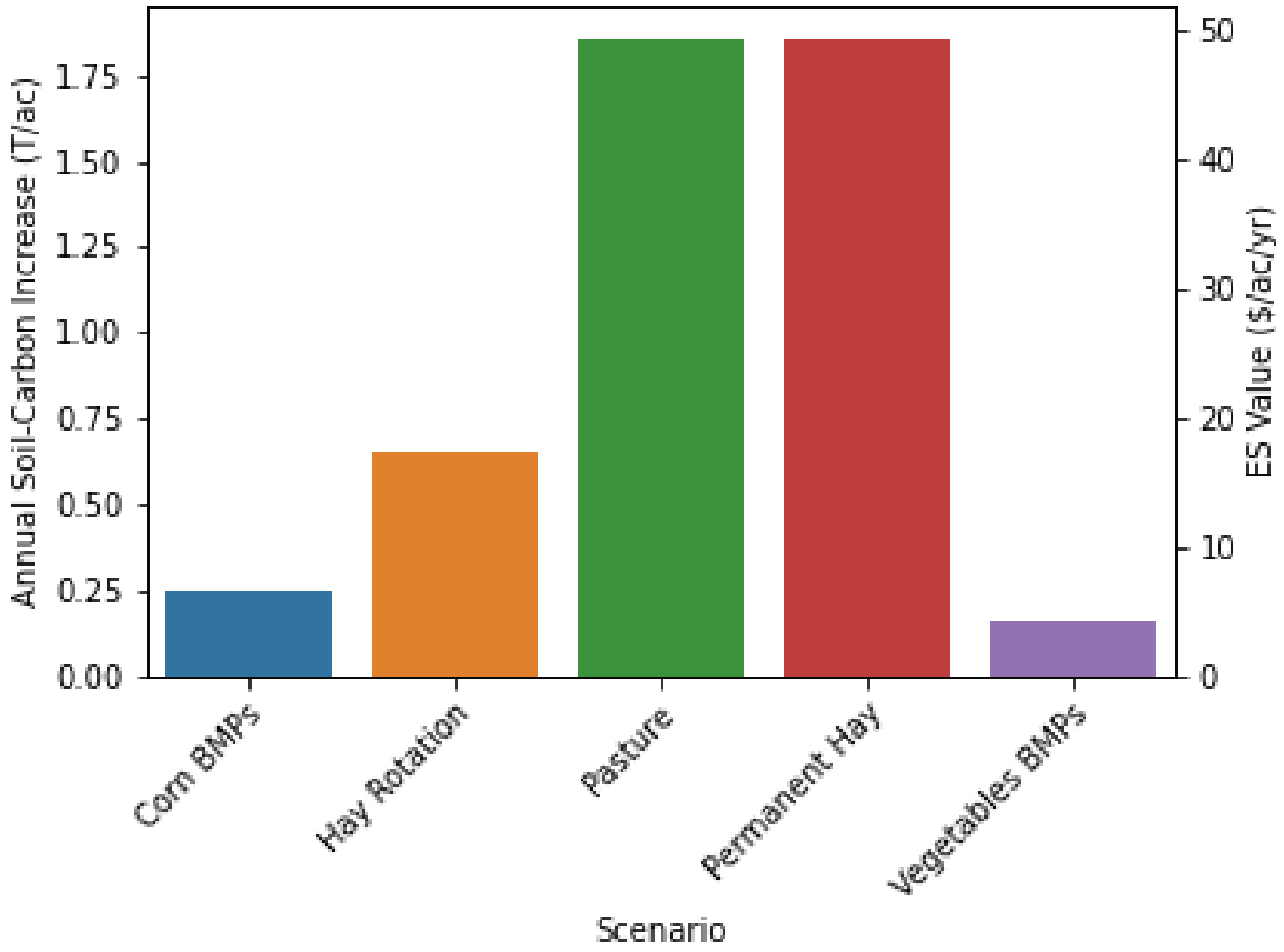
Soil Carbon Storage

- Calculated differently for Soil Indicators vs Practices.
- Practices: Literature values for an accumulation rate, paired with $15/ton CO2 offset price, discounted by 50% for impermanence. Gives annual payments for ~10 years.
- Soil Indicators: We calculate the climate-mitigation value of storing 1 Ton of carbon for 1 year. Gives values for *indefinite* annual payments, if soil C levels are maintained. $1.09/T/year SOC.

Annual Climate Mitigation Benefits from Carbon Storage: Grouped by Soil Texture



Soil Carbon Accumulation: Practices



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No Results Yet (Notes in the Report)

- Nitrogen
  - 5 different pathways to consider, each with different harms, which vary spatially. Some practices / soil indicators increase some losses but decrease others.
  - The total value of N-Loss harms is fairly high, may be ~$100/acre/year from some dairy cropping systems.
- Biodiversity
  - The report briefly explores how soil biodiversity might be valued, would require substantial original research.

Questions? Thanks!

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